

**REQUEST FOR WITHDRAWAL OF FINALITY AND AMENDMENT AFTER FINAL REJECTION
UNDER 37 C.F.R. § 1.116**

Applicant: Michael Paul Tankard

Serial No.: 10/656,821

Filed: September 5, 2003

Docket No.: K315.131.101

Title: CIRCUIT FOR USE WITH SWITCHED RELUCTANCE MACHINES

Amendments to the Drawings:

The attached drawing sheet adds a legend to Figure 7 and replaces the original sheet including Figures 7 and 8.

Attachments: Replacement Sheet

Annotated Sheet Showing Changes

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REMARKS

Claims 1-15 are amended. By this Amendment, the drawings are amended.

I. Request for Withdrawal of Finality

The finality of the June 3, 2005 Office Action is improper and should be withdrawn, because the Office Action applied a new ground of rejection not necessitated by Applicant's Amendment filed March 17, 2005. Specifically, that Amendment left claim 14 unamended, but the June 3, 2005 Final Rejection applied an entirely new ground of rejection against claim 14. Whereas the first Office Action rejected original claim 14 under 35 U.S.C. § 102(b) and/or § 103 under Berroth, Labriola and Ferreria, the Final Office Action rejected original claim 14 under 35 U.S.C. § 102(b) over Webster. Because independent claim 14 is an original claim and has not been amended, the 35 U.S.C. § 102(b) rejection over Webster in the Final Rejection constitutes a new ground of rejection that was not necessitated by Applicant's Amendment.

Accordingly, Applicant submits that the finality of the June 3, 2005 Office Action is improper and should be withdrawn.

II. Replacement Drawing Sheet

The June 3, 2005 Office Action indicated that Figure 7 should be designated by a legend such as --Prior Art--. By this Amendment, a Replacement Sheet including Figure 7 with such a legend is submitted. Applicant requests approval of this drawing change.

III. Prior Art Rejections over Webster, Morris and Ramarathnam

The June 3, 2005 Office Action rejected claims 1-5 and 12-15 under 35 U.S.C. § 102(b) over Webster (U.S. Patent No. 5,847,532), claims 6-7 under 35 U.S.C. § 103(a) over Webster in

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view of Morris (U.S. Patent No. 6,137,256), and claims 6-7 and 9-11 under 35 U.S.C. § 103(a) over Webster in view of Ramarathnam (U.S. Patent No. 6,316,895). Applicant respectfully traverses these rejections.

A. Webster does not Teach Switches Arranged to Conduct Current in Both a First and a Second Direction

Independent claim 1, lines 4-5, recites that the switches of the first and second set are arranged to conduct current in both a first and a second direction. Webster fails to disclose this feature and thus fails to anticipate independent claim 1 or its dependent claims.

Switches 14, 16 of each set A and B in Webster's Figure 3 are connected between a higher and a lower voltage such that current flows through windings L1 and L2 from left to right in Figure 3. For current to reverse in switches 14, 16, the current would have to flow from right to left in windings L1 and L2. However, in the circuit of Figure 3, this is not possible because of diodes 18, 20. Thus, there is nothing in the circuit of Webster's Figure 3, or anywhere else in Webster, that would cause current to flow through switches 14, 16 in both a first direction and a second direction, as recited in independent claim 1.

Moreover, only a limited class of switches is capable of conducting current in both a first direction and a second direction. One particular example of such a switch is a MOSFET switch. There is no disclosure of a MOSFET switch or any other capable switch in Webster. Furthermore, Webster fails to provide any motivation for modifying its switches to include the feature of conducting current in both a first and second direction. It should also be noted that the uni-directionality of the switches 14 and 16 of Webster is indicated by the respective arrows in Figure 3. Webster discloses as specific switch examples IGBT (insulated gate bi-polar

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transistors) (see column 2, lines 3-6 of Webster) or GTO (gate turn-off thyristors) (see column 2, line 10 of Webster). These switches are simply incapable of conducting current in a first direction and a second direction, as recited in independent claim 1.

In the objection against claim 1, the Office Action cites passages at column 1, line 59 – column 2, line 2 and column 3, line 60 – column 4, line 13 of Webster. However, these passages do not teach switches conducting current in a first direction and a second direction. Further, this feature as claimed would be inconsistent with the disclosure of Webster. In the first cited passage, current is supplied via a switch and returned via a diode. Current thus always flows in the same direction through the switch. The second cited passage describes the arrangement of Figure 3, which, as described above, is incapable of conducting current in both a first direction and a second direction through switches 14 and 16.

In view of the foregoing, Applicant submits that independent claim 1, and its dependent claims, define patentable subject matter.

B. Webster does not Teach Current Flowing in Different Directions in Different Modes of Operation (Motoring and Generating)

Independent claim 12, lines 6-9, recites, during a motoring mode, supplying current via a first set of switches and providing a path for returning current to the supply via a second set of switches, and, during a generating mode, supplying current via the second set and returning current to the supply via the first set. Independent claim 14, lines 6-9, recite, during a motoring mode, supplying current to the phase winding via the first set and returning current to the supply via the second set and, during a generating mode, supplying current to the phase winding via the

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second set and returning current to the supply via the first set. Independent claim 15 and dependent claim 2 recite similar features.

In contrast to the Office Action's assertion against dependent claim 2 and independent claims 12, 14 and 15, it is not inherent in Webster that current flows in one direction during motoring and another direction during generating. In a switched reluctance machine, current generally flows in the same direction in both motoring and generating modes and there is generally no incentive to change this. Specifically, there is no teaching or suggestion in Webster of this claimed feature, and, in fact, this feature could not be achieved using the circuit of Webster.

In one electrical cycle of operation, the current through the switches and winding of Webster is in one direction only. While the switches are closed, energy is drawn from the supply. (In the example of Figure 3, current flows from V+ to N via switch 14, winding L1 from X to Y and switch 16). When the switches are opened, the winding current continues to flow from X to Y due to the inductance of the winding. Since the switches are now open, the current now must flow through the diodes 18 and 20 and return to the supply against the supply voltage. Some energy is thus returned to the supply, but that return is through *diodes 18, 20*.

Importantly, the current flows in the same direction through the winding at all times during one phase cycle. As the switches are open, the current decays due to the reverse voltage applied via diodes 18 and 20, and then, when current has decayed to 0, diodes 18, 20 are reverse-biased such that no more current flows. Thus, there can be no reverse current flow in one phase cycle. In fact, in the arrangement of Figure 3 of Webster, the direction of current is dictated by the arrangement of the switches and the diodes.

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Whether the machine works as a motor or a generator depends on the timing of the operation of the switches, and, thus, the reversal of the voltage seen by the winding. It does *not* depend on the direction of the current (see, for example, page 4, line 25 – page 5, line 5 of the present application). Because whether the machine operates as a generator or a motor does not depend on the direction of the current, it is possible to arrange for the current to be in different directions during generation and motoring. However, Webster provides absolutely no teaching, suggestion, or incentive to do so. There is no indication in Webster of why this would be desirable, and, again, it could not be achieved using the circuit of Webster.

By contrast, embodiments of the invention take advantage of the fact that the direction of the current *can* be opposite for motoring and generating. Using two sets of switches for the same winding, instead of a set of a set of switches and a set of diodes (as in Webster), the direction of current is determined by which set of switches is actively switched. As stated above, this allows the current to be routed differently for motoring and generating modes, such that one set of switches can have a reduced current rating if desired. The advantage of having different current directions for motoring and generating only becomes apparent with knowledge of the present invention; such advantages are clearly not apparent from, or taught or suggested by, Webster.

Applicant submits, therefore, that at least independent claims 12 and 14-15 and dependent claim 2 define patentable subject matter.

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C. Webster does not Teach or Suggest Two Sets of Switches having Different Current Ratings

Independent claim 1, last two lines, recites switches of the first set being rated for a higher current than switches of the second set. Also see independent claims 12 and 15, last two lines of each claim.

There is no teaching of this feature anywhere in Webster. If this rejection over Webster is maintained in a subsequent Office Action, Applicant respectfully requests that it be particularly pointed out where in Webster this teaching is believed to occur.

An object of Webster is to enable the use of switches having a lower current rating than would usually be necessary for a given supply voltage. Webster achieves this object by splitting the winding into two parts L1 and L2, each part being controlled by its own set of switches, such that each set of switches sees only half the total voltage. (See e.g., column 4, lines 43-49.) Since both switches experience the same supply voltage ($0.5 V_s$), it would be nonsensical to rate the switches differently. Thus, Webster does not only fail to disclose this feature, but clearly teaches against it. The passage quoted by the Office Action against this feature (column 2, line 65 – column 3, line 7) provides no disclosure whatsoever of differently rated switches. To the contrary, this passage states that the voltage is shared between sets of switches in a stable, self-balancing manner. This passage cited by the Office Action, therefore, only reinforces the fact that the switches of Webster should be rated to the *same* current because they experience the same supply voltage.

Embodiments of the invention allow one set of components to have a lower current rating by providing two sets of switches that can both supply and return current. Thus, the circuit can

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be controlled such that the higher current flows through the higher rated component, and the lower current flows through the lower rated components, irrespective of the mode of operation. There is no disclosure of any of this in Webster. Webster provides no reason whatsoever to provide differently rated sets of switches, as claimed.

D. Webster does not Teach Switches that Return Current to the Supply

Independent claim 1, lines 3-4, recites a first set and a second set of switches for supplying current to the phase winding and *returning current to the supply*. Also note independent 12, lines 7-9, independent claim 14, lines 7-9, and independent claim 15, lines 6-8. In Webster, on the other hand, in e.g. the circuit of Figure 3, current can flow through switches 14, 16 in only one direction from a high voltage to a low voltage, thus supplying current to inductors L1 and L2. Reversing the direction of current flow to return current to the supply through the switches is impossible. Since the switches supply current to the inductors L1 and L2, it is impossible for the switches to also return current to the supply, since this would require a reversal of the current direction in the switches.

Webster teaches, in column 4, lines 24-34, three switch settings for the circuit of Figure 3:

- All four switches being closed, supplying current to the winding.
- One switch of each set of switches being open, re-circulating current through the other closed switch and the diode.
- All switches being open, returning current to the supply via the *diodes*, not the switches. (See e.g. Webster column 4, lines 32-34).

Accordingly, Applicant submits that independent claims 1, 12, 14 and 15, and the associated dependent claims, define patentable subject matter.

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E. Morris and Ramarathnam do not Remedy Webster's Shortcomings

The only relevance of Morris and Ramarathnam is that they mention MOSFETs. Morris merely lists MOSFETs as one possible switching device. Ramarathnam does not comment on using MOSFETs in Webster's circuit; he merely notes the use of such devices to make the design of the switched driver circuit (which is not even mentioned in Webster) somewhat simpler. None of this has any bearing on the claimed invention, and neither Morris nor Ramarathnam teach any of the features discussed above that are missing from Webster.

F. Dependent Claims

The dependent claims recite additional features, not taught or suggested by the prior art.

Dependent claim 4, for example, recites at least one of the switches being capable of operating as a diode. Webster's switches are incapable of operating as diodes, and do not include the ability to so perform, contrary to what is stated in the Office Action. There is neither teaching that they can operate as switches, nor ability to do so. In fact, in their position in Webster's circuit, it is impossible for the switches to act as diodes, in part because they are in completely in the wrong place to do so.

Regarding dependent claim 5, which recites at least one switch having an inherent integral reverse diode, Webster never mentions an inherent integral reverse diode. Only certain types of switches can act as diodes, and Webster's simply do not.

Dependent claim 8 recites the first set comprising two switches that are rated to a higher rating than the remaining two switches forming the second set. Contrary to what is stated in the Office Action, Webster splits the load into equal portions, and the switches of Webster all have

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to be capable of carrying the same current. There is simply no teaching or suggestion in Webster to have two switches rated to a higher current rating than two other switches, forming the first and second sets, as claimed.

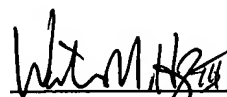
Conclusion

In view of the foregoing, Applicant submits that this application is in condition for allowance. Favorable reconsideration and prompt allowance are requested. The Commissioner is hereby authorized to grant any extensions of time and to charge any fees under 37 C.F.R. § 1.16 and § 1.17 that may be required during the entire pendency of this application, or to credit any overpayment, to Deposit Account No. 500471.

The Examiner is invited to telephone the undersigned to advance prosecution.

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Respectfully submitted,



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Please grant any extension of time necessary for entry; charge any fee due to Deposit Account No. 500471.

CERTIFICATE UNDER 37 C.F.R. 1.8:

The undersigned hereby certifies that this paper or papers, as described herein, are being deposited in the United States Postal Service, as first class mail with sufficient postage, in an envelope addressed to Mail Stop AF, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on this 27th day of July 2005.

By 

Name: William M. Hienz III

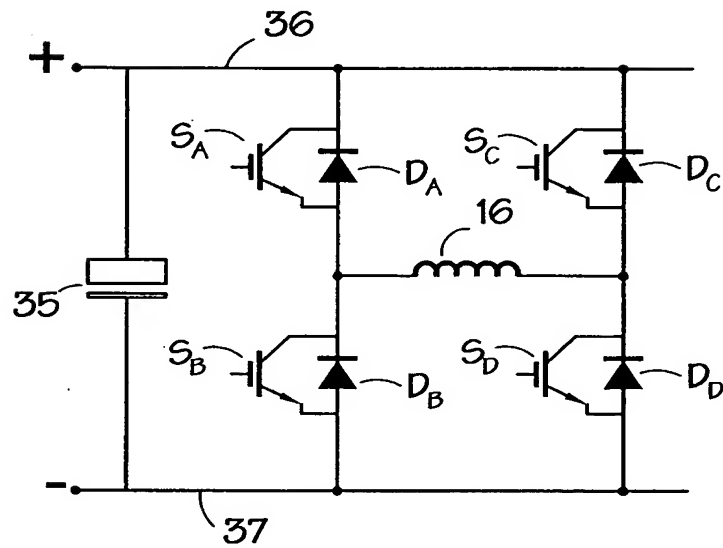


Fig 7
-- Prior Art --

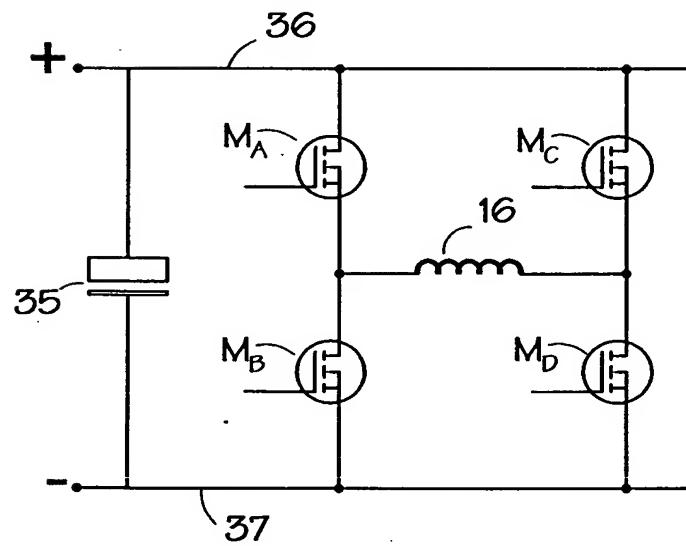


Fig 8